MODELING PROTOCOL
for the

SALT LAKE COUNTY
SULFUR DIOXIDE REDESIGNATION STUDY

SEPTEMBER 2001

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

A. Overview

In 1978, Salt Lake County and Tooele County were designated as not attaining the sulfur dioxide (SO_2) primary and secondary National Ambient Air Quality Standards (NAAQS). The U.S. Environmental Protection Agency (USEPA) based the designation on measured SO_2 concentrations in the two counties. In early 1981, the USEPA revised the non-attainment designation of Tooele County to only that portion of the county above 5600 feet. Currently, the only two areas in the State of Utah (State) not meeting the SO_2 NAAQS are Salt Lake County and the portion of Tooele County above 5600 feet (40 CFR Part 58).

B. Objective

Following federal guidance (USEPA 1992a), the State will be requesting an SO_2 area redesignation from non-attainment to attainment for Salt Lake County and Tooele County above 5600 feet. The request will be based in part, on measured and model predicted SO_2 concentrations as well as on previous studies the State has provided to USEPA Region 8. Not included in the previous studies were the modeled concentrations of the five refineries located along the Wasatch Front in Salt Lake County and Davis County. As a result, the Utah Division of Air Quality (UDAQ) will address this deficiency by modeling the five refineries and determining its concentrations in Salt Lake County. Concentrations will only be predicted in Salt Lake County since UDAQ is seeking redesignation for this area. The Kennecott Utah Copper predicted concentrations in Salt Lake and Tooele counties were provided in earlier studies.

This *Modeling Protocol for the Salt Lake County Sulfur Dioxide Redesignation Study* describes the procedures, assumptions, data, and models that are likely to be used by the UDAQ to predict ambient SO_2 concentrations. UDAQ is planning to employ the American Meteorological Society (AMS)/EPA Regulatory Model Improvement Committee (AERMIC) Model (AERMOD) system of programs (AERMOD modeling system), and the Industrial Source Complex-Plume Rise Model Enhancement (ISC-PRIME) program to predict ambient concentrations. The AERMOD modeling system consists of (1) the AERMOD Meteorological Preprocessor (AERMET), (2) the AERMOD Terrain Preprocessor (AERMAP) and (3) the AERMOD dispersion model which uses the output from AERMET and AERMAP to predict ambient air pollutant concentrations. Since both the AERMOD modeling system and ISC-PRIME have not been codified in 40 CFR Part 51, UDAQ is requesting USEPA Region 8 approval to use these two models and concurrence on the procedures, assumptions, and data.

AERMOD and ISC-Prime were selected for this study because:

1. These two models have been proposed as Appendix A models in Appendix W of 40 CFR Part 51. The proposal was announced in the Federal Register of May 19, 2000 (Volume 65, Number 93).
2. Both models have undergone extensive scientific review and evaluations in the last few years which demonstrated that (a) ISC-PRIME is technically superior to ISC3 in evaluating wake effects, and (b) AERMOD is technically superior to ISC3 in predicting concentrations in any terrain modeling situation. Numerous papers have been presented at the Air & Waste

Management Association and American Meteorological Society meetings and journals related to performance of these two models.

3. Both models are based on current science.

In performing the study, UDAQ will follow the recommendations and guidance contained in the following references.

- Guideline on Air Quality Models, Appendix W of 40 CFR Part 51
- Revised Draft User's Guide for the AMS/EPA Regulatory Model - AERMOD (USEPA 1998a)
- Revised Draft User's Guide for the AERMOD Terrain Preprocessor (AERMAP) (USEPA 1998b)
- Revised Draft User's Guide for the AERMOD Meteorological Preprocessor (AERMAP) (USEPA 1998c)
- User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume I - User Instructions (USEPA 1995a)
- Addendum to ISC3 User's Guide, The Prime Plume Rise and Building Downwash Model (ETI 1997)
- EPA comments on draft modeling for Salt Lake County SO2 redesignation letter of December 7, 2001 (USEPA 2000e)

A technical support document (TSD) will be developed to support the model predictions and area redesignation. The TSD will expand on the discussions contained in Section 3 of this modeling protocol, and will include tabular and graphic summaries of model predicted concentrations. A CD-ROM containing the all model input and output files, BPIP and BPIP-PRIME input and output files, and the preprocessed meteorological data sets will be attached to the TSD. Modeling results provided by any of the five refineries to UDAQ to support the redesignation will also be included in the TSD as appendices.

II. BACKGROUND

A. Area Designation

In 1978, the USEPA designated two areas within the State as non-attainment for meeting the SO_2 NAAQS: Cedar City and an area encompassing Salt Lake and Tooele Counties. On February 19, 1980, the USEPA approved the State's control strategy for SO_2 for Cedar City, but disapproved the strategy for the Salt Lake County and Tooele County non-attainment areas. In early 1981, the USEPA revised the non-attainment designation for Tooele County to exclude all areas except the area above 5600 feet. Later in 1981, the State submitted a state implementation plan (SIP) revision for the control of SO_2 in the Salt Lake County and Tooele County non-attainment areas. The submittal included a map redefining the boundaries of the non-attainment area as Salt Lake County and the portion of Tooele County above 5600 feet. Cedar City was redesignated an attainment area at the end of 1983. In 1985, the USEPA approved the SIP revision demonstrating attainment of the NAAQS for SO_2 on an interim basis. Final approval was contingent upon resolution of certain issues surrounding Good Engineering Practice (GEP) stack height demonstration. The State submitted its GEP SIP in 1986, with subsequent submittals in 1986, 1987, and 1988. USEPA proposed approval of the GEP SIP in 1988, but subsequent comments regarding land ownership on elevated terrain delayed final approval.

In 1990, the Clean Air Act was amended resulting in an automatic SIP call for any non-attainment area that did not have a fully approved SIP. Since the State SIP had never received full final approval, the State was again required to submit SIPs for both the GEP stack height and the control of SO_2 in the Salt Lake County and Tooele County non-attainment areas. All other areas of the State, including Cedar City, were shown to have ambient air that is "better than national standards." The appropriate SIP revisions were submitted in 1991 and 1992 and subsequently approved by EPA in 1994.

Since 1981, there has not been a measured violation in the non-attainment areas of any primary or secondary NAAQS for SO_2. This lack of a monitored violation is the result of permanent and enforceable emission reductions at the source responsible for the violations which led to the non-attainment area designation. It should be mentioned that the State and USEPA believed that the Kennecott Utah Copper operations contributed to the measured violations which have since been mitigated.

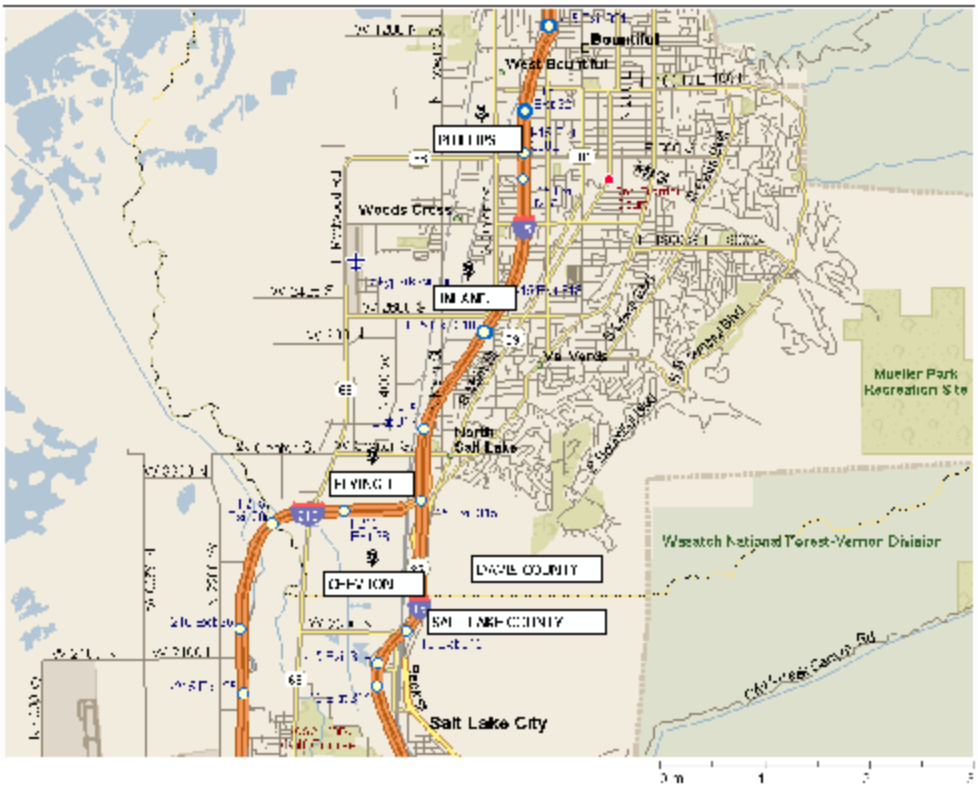
B. Area Description

The focus of this modeling study is on the five petroleum refineries located west of the Wasatch Range and the Wasatch National Forest and their predicted concentrations in Salt Lake County. The BP Amoco refinery (BP) is located in Salt Lake County while the Chevron USA Products Company refinery (Chevron), Flying J Incorporated refinery (Flying J), Phillips 66 Company refinery (Phillips) and Inland Refining Company refinery (Inland) are all located in Davis County. Figures II-1 and II-2 shows the location of each refinery in their respective counties.

Salt Lake County encompasses an area approximately of 764 square miles. The population of Salt Lake County was 725956 as of the 1990 census. The projected population of Salt Lake County for the year 2000 was 848083. Salt Lake City occupies an area of about 90.5 square

FIGURE II-1
SOURCE LOCATIONS IN SALT LAKE COUNTY

FIGURE II-2
SOURCE LOCATIONS IN DAVIS COUNTY



miles and has a population of 174348 as of 1999, which exceeds its year 2000 projection. The projected population of Salt Lake City for the year 2000 was172930.

Specific land uses within a three kilometer radius of each refinery is discussed in Section III.

C. Sulfur Dioxide Emission Sources

Besides the five refineries, there are other types of stationary sources in Salt Lake County that emit SO_2. They include Kennecott copper mine and refinery, brick manufacturing facilities, concrete plants and asphalt plants. The criterion agreed upon between USEPA Region 8 and UDAQ (2001a) was that if a stationary source emits at least 100 tons per year of SO_2 (major source) and is located within a ten kilometer radius, it would be considered a nearby source and included in the modeling. Review of UDAQ data files revealed that there are no other major sources of SO_2 within 10 kilometers of any of the five refineries.

D. Air Quality and Meteorological Monitoring Stations

Prior to 1997, UDAQ operated an air quality and meteorological (wind) monitoring station in North Salt Lake. In early 1997, UDAQ discontinued meteorological measurements while retaining the SO_2 collection program. Consequently, the most recent and complete five year period of record for meteorological data was 1992 to 1996.

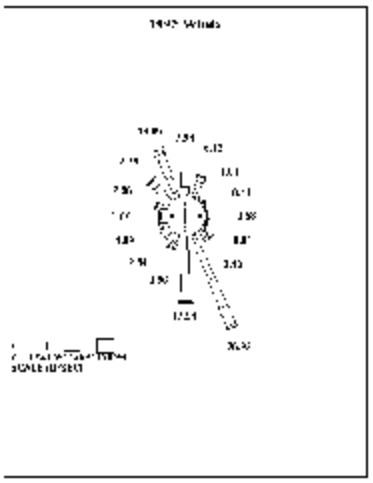
The monitoring station is located between the Chevron and BP refineries, and east of Interstate-15 as shown in Figure II-1. BP is located about 2000 meters southeast of the monitoring station. Chevron and Flying J are located approximately 1900 meters and 3200 meters north of the monitoring station, respectively. Inland is located roughly 6700 meters north-northeast of the monitoring station location and Phillips is located about 8800 meters north-northeast of the monitoring station location. Using a North American 1927 Datum (NAD27) and a Universal Transverse Mercator (UTM) map projection, the monitoring station is located at 422386 meters East, 4517369 meters North, Zone 12.

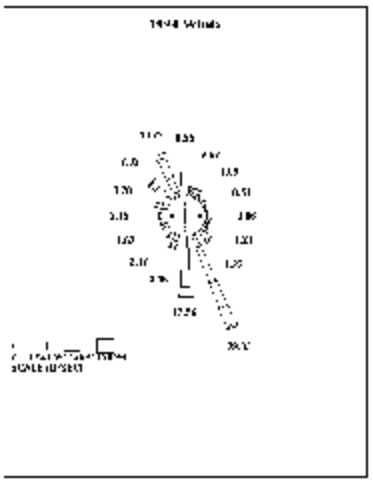
Salt Lake City International Airport, located approximately five kilometers southwest of the North Salt Lake monitoring station, records meteorological variable data. The data includes hourly surface observations and upper air data.

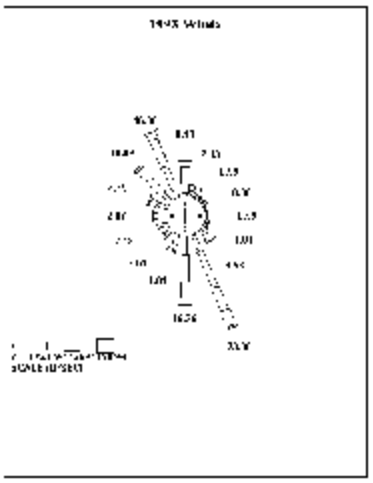
Figure II-3 shows four calendar year wind roses for the period 1992 to 1995. In general, North Salt Lake area wind measurements during the period have been consistent with a primary flow from the south-southeast and a secondary flow out of the north-northwest.

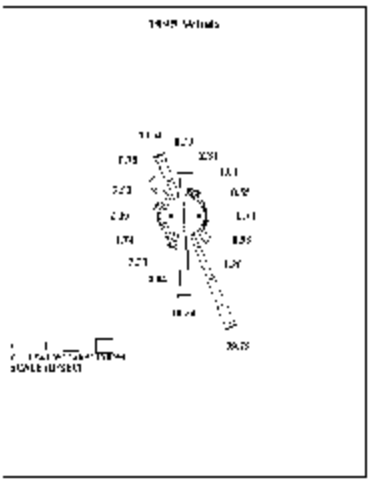
Calendar year 1996 was eliminated from the study because of missing meteorological data and because data collection at the Salt Lake City International Airport switched to the Automated Surface Observing System (ASOS). Salt Lake City International Airport surface and upper air observations along with North Salt Lake wind data are needed to generated the meteorological data base to drive the air quality models.

FIGURE II-3
NORTH SALT LAKE WIND ROSES - 1992 TO 1995









III. MODELING ASSUMPTIONS AND METHODOLOGY

A. Digitized Elevation Model Data

To define the receptor points and elevations (x, y, z) in the modeling domain, UDAQ will use 7.5-minute Digitized Elevation Model (DEM) data from Bountiful Peak, Farmington, Fort Douglas and Salt Lake City North. The DEM data files consist of an array of elevations referenced horizontally to the geographic coordinate system of NAD27. The DEM data itself is based on 30- by 30-meter data spacing with a UTM map projection.

The DEM data will be downloaded from the U .S. Geological Survey (USGS) site and run through the program SDTSEDEM to reformat the data to a standard DEM file.

B. Receptor Locations and Terrain Elevations

UDAQ has downloaded the DEM data and defined the modeling domain to be a rectangular area located in the north central portion of Salt Lake County. The east to west extent and the south to north extent are 4106 meters and 5170 meters, respectively. The rectangular area is approximately 21 square kilometers. Ground level elevations range from 1282 meters to 1816 meters. Figures III-1 is a 2-dimensional contour map showing the locations of the five refineries within the modeling domain and the receptor gridded area within Salt Lake County which was under evaluation. Figure III-2 shows a 3-dimensional topographic map of the receptor grid area.

The initial modeling domain consists of 2668 points spaced at 90-meters. The 90-meter spacing was selected to minimize interpolation between points and to eliminate modeling a coarse grid followed by a refine grid.

UDAQ will make two changes to the initial modeling domain to evaluate wake effects. First, it will add 30-meter maximum spaced receptors along the BP refinery plant property and exclude any receptor points inside the plant property. There is a physical barrier at BP to prevent public access. Only property line receptors are needed at BP because it is the only refinery within Salt Lake County. Second and only if the ISC-PRIME Model is used, the UDAQ will include those receptor points from the initial modeling domain with elevations that are less than the tallest physical stack found at the BP, Chevron and Flying J refineries. UDAQ believes that (1) the source contributions from Inland and Phillips inside Salt Lake County and (2) the source contributions from Chevron and Flying J inside the BP refinery will both be insignificant. The basis for this belief is the long distance from the refineries to Salt Lake County and BP.

A receptor point was not specifically located at the UDAQ North Salt Lake monitoring station site. The monitoring station site will be represented by the nearest receptor point. The UTM coordinates of the monitoring station site is 422386 meters East, 4517369 meters North.

FIGURE III-1
Modeling Domain and Receptor Grid

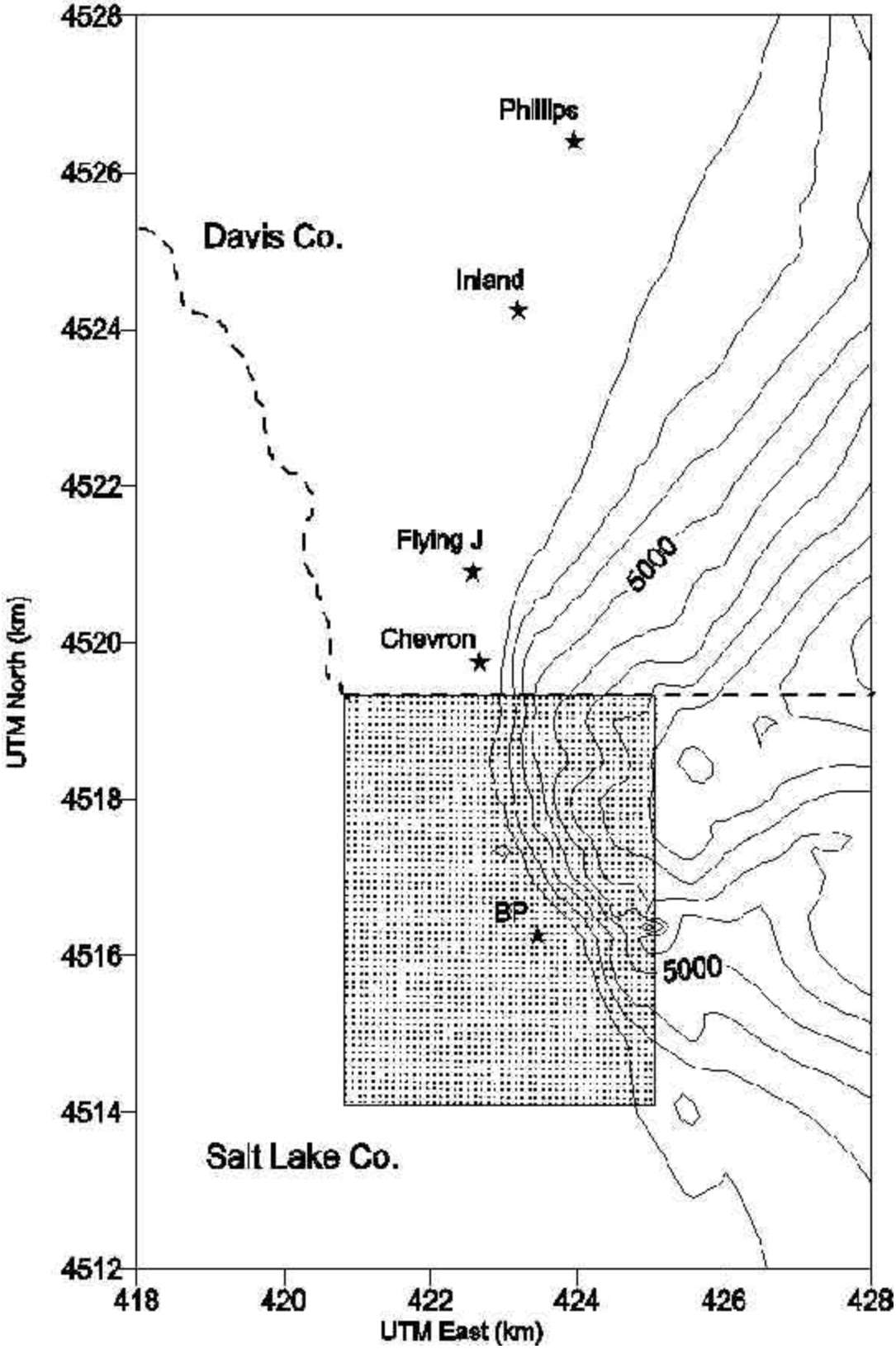
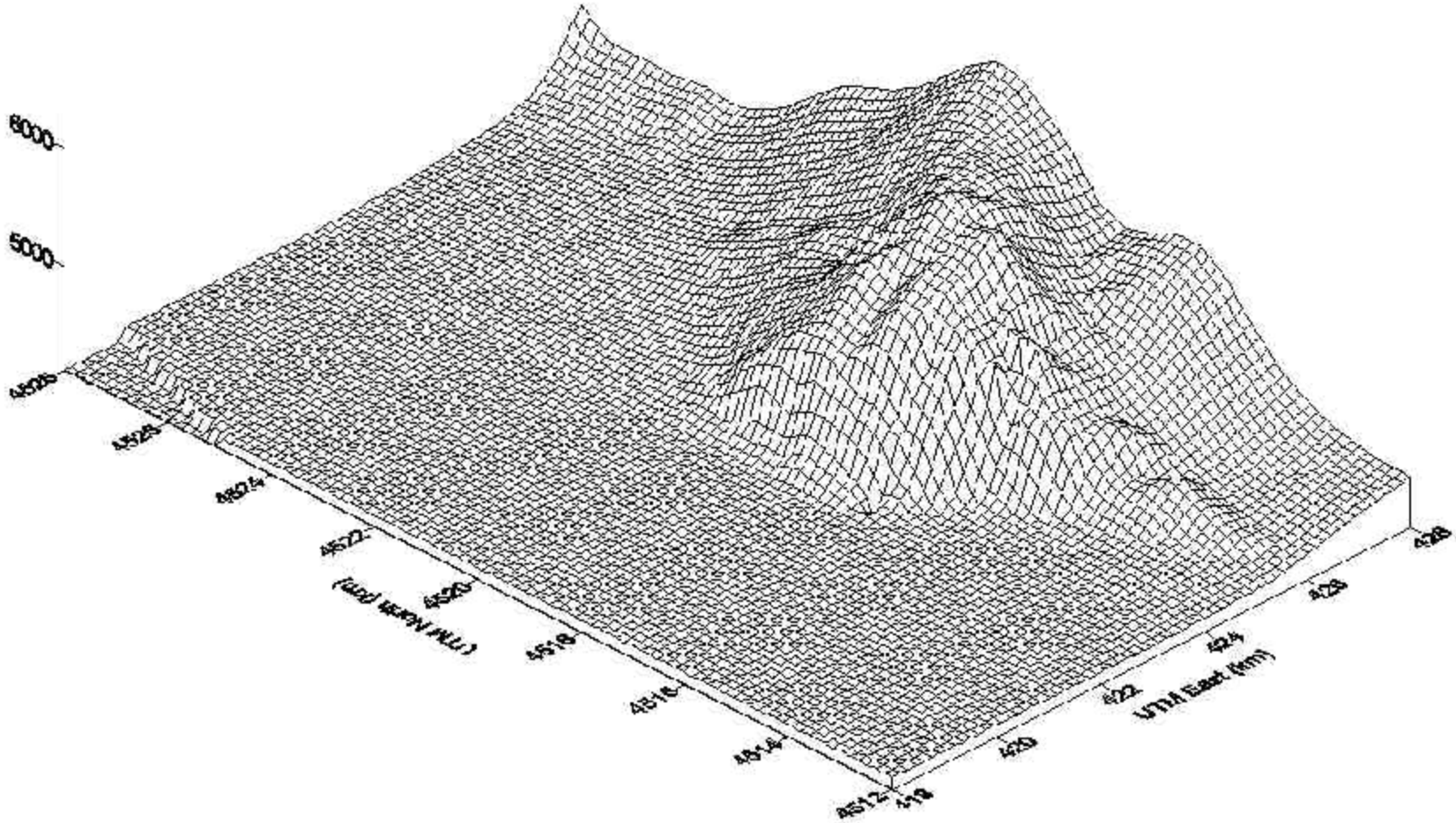


FIGURE III-2


6000
5000
4526
4524
4522
4520
4518
4516
4514
4512
(UTM Northing (km))
418
420
422
424
426
428
UTM Easting (km)

C . Urban/Rural Determination

In Appendix W of 40 CFR Part 51, USEPA guidance states that either land use or population density within a 3-kilometer radius of the source location must be used to determine if the area is urban or rural for modeling purposes. It also states that land use is the more definitive method.

Consistent with guidance and Auer (1978), UDAQ has determined the land use within a 3-kilometer radius of each refinery as shown in Figures III-3 to III-7. At each refinery location, more than 50 percent of the area is either designated common residential (R1), estate residential (R4), metropolitan natural (A1), agricultural (A2), undeveloped, uncultivated and wasteland (A3), undeveloped rural (A4), water surfaces (A5), or roads & vacant . Although not an Auer designation, road & vacant land use is considered rural by UDAQ. Therefore, the five areas are rural for modeling purposes.

Using BP as an example, Appendix B contains a May 9, 2001 letter which discusses in more detail how UDAQ arrived at the rural determination. The road & vacant land uses were refined in the determination.

D. Background Air Quality

UDAQ will use representative SO_2 concentration measurements from 1994 to 1996 to establish background air quality levels. Following Prevention of Significant Deterioration (PSD) monitoring guidance (USEPA 1987), existing data is deemed representative if three conditions are satisfied. The conditions are: (1) the location of the monitoring station is within a certain area, (2) the monitoring station has been audited in accordance to specific requirements, and (3) the data is current. Below is a discussion of how the North Salt Lake data satisfies the conditions.

As discussed in Section II.D., the monitoring station is located in Salt Lake County, between BP and Chevron, and east of I-15. All five refineries are within 8800 meters of the monitoring station. The monitoring station is expected to be located inside the impact area of the three nearest refineries which will have the greatest impact in Salt Lake County. The first condition is met.

The North Salt Lake monitoring station is part of a State and Local Air Monitoring Station (SLAMS) network which adheres to the quality assurance requirements in Appendix A to 40 CFR Part 58. Performance of the scheduled audits have resulted data recoveries of 96 percent, 93 percent, and 97 percent for calendar years 1994, 1995, and 1996, respectively. These percentages exceed the PSD requirement of 80 percent on an annual basis (USEPA 1987). The second condition is met.

A three year period of air quality measurements from 1994 to 1996 was selected for this study to match as closely as possible with the meteorological data period of record that will be used in the air quality modeling. Although the period of record falls outside of the three year window, this exception should not have a negative effect because measured the SO_2 background concentration levels at North Salt Lake have been trending downward. The third condition is met.

FIGURE III-3
LAND USE WITH A 3 KILOMETER RADIUS OF THE BP REFINERY

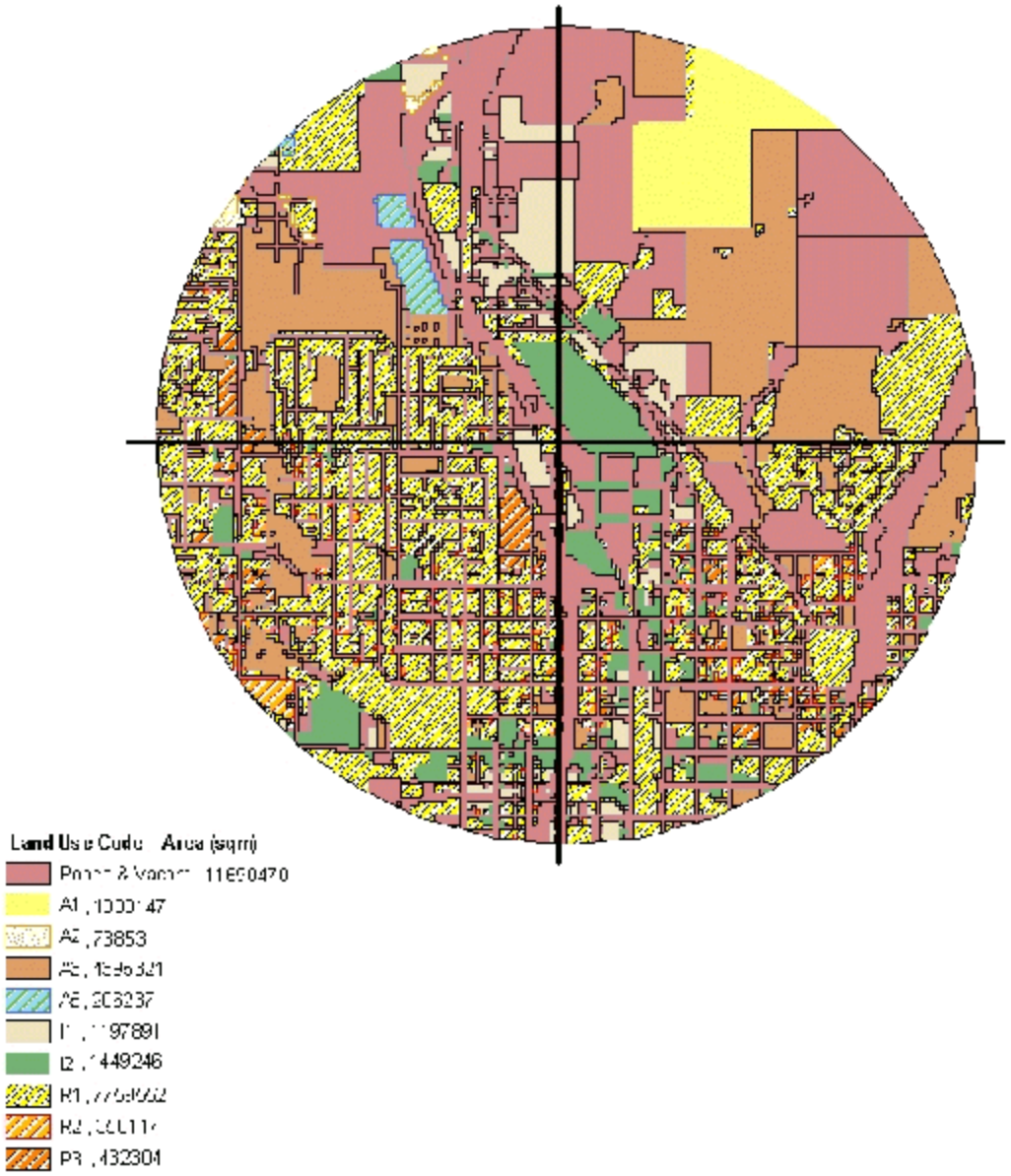


FIGURE III-4
LAND USE WITHIN A 3 KILOMETER RADIUS OF CHEVRON

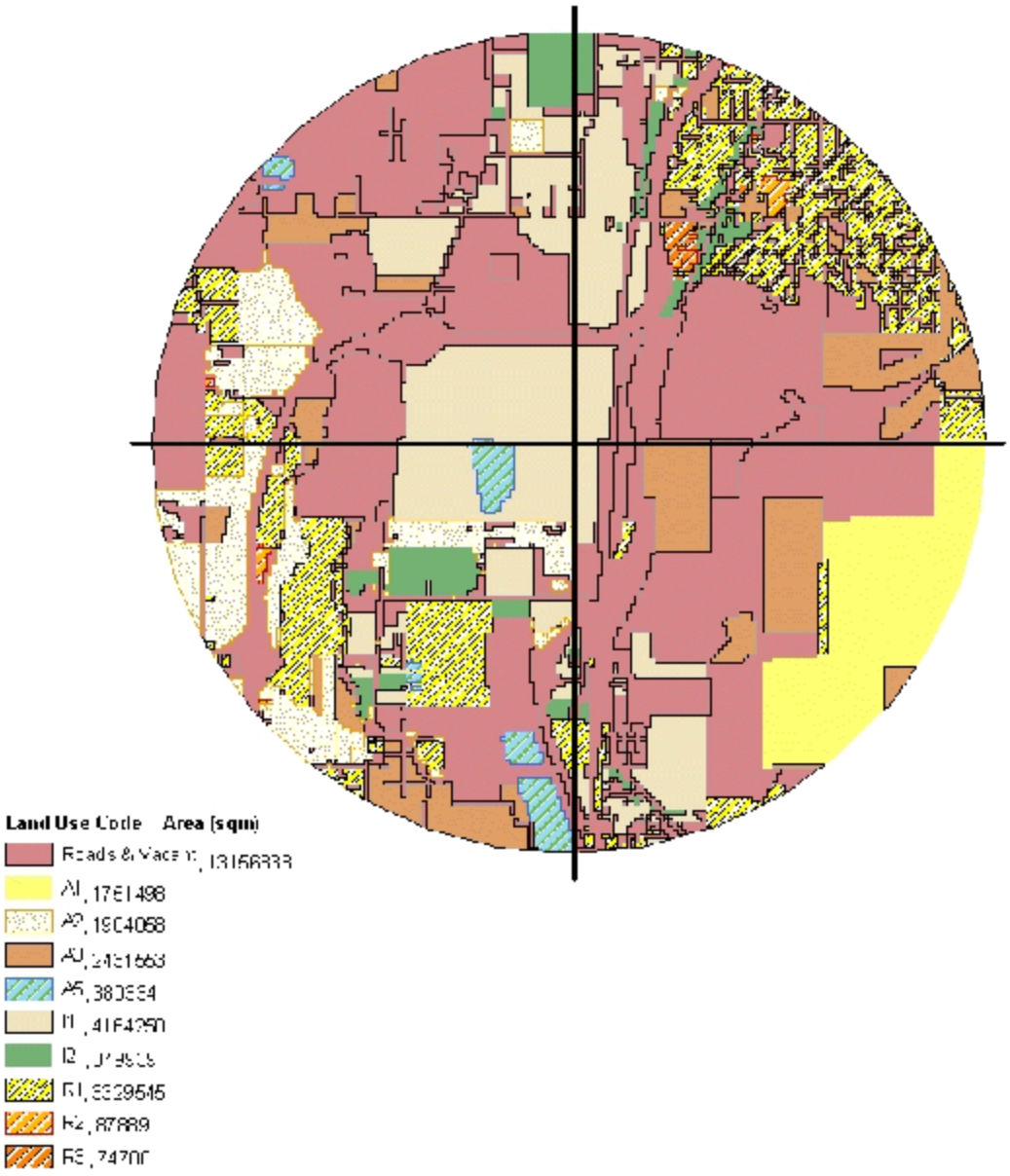


FIGURE III-5
LAND USE WITHIN A 3 KILOMETER RADIUS OF FLYING J

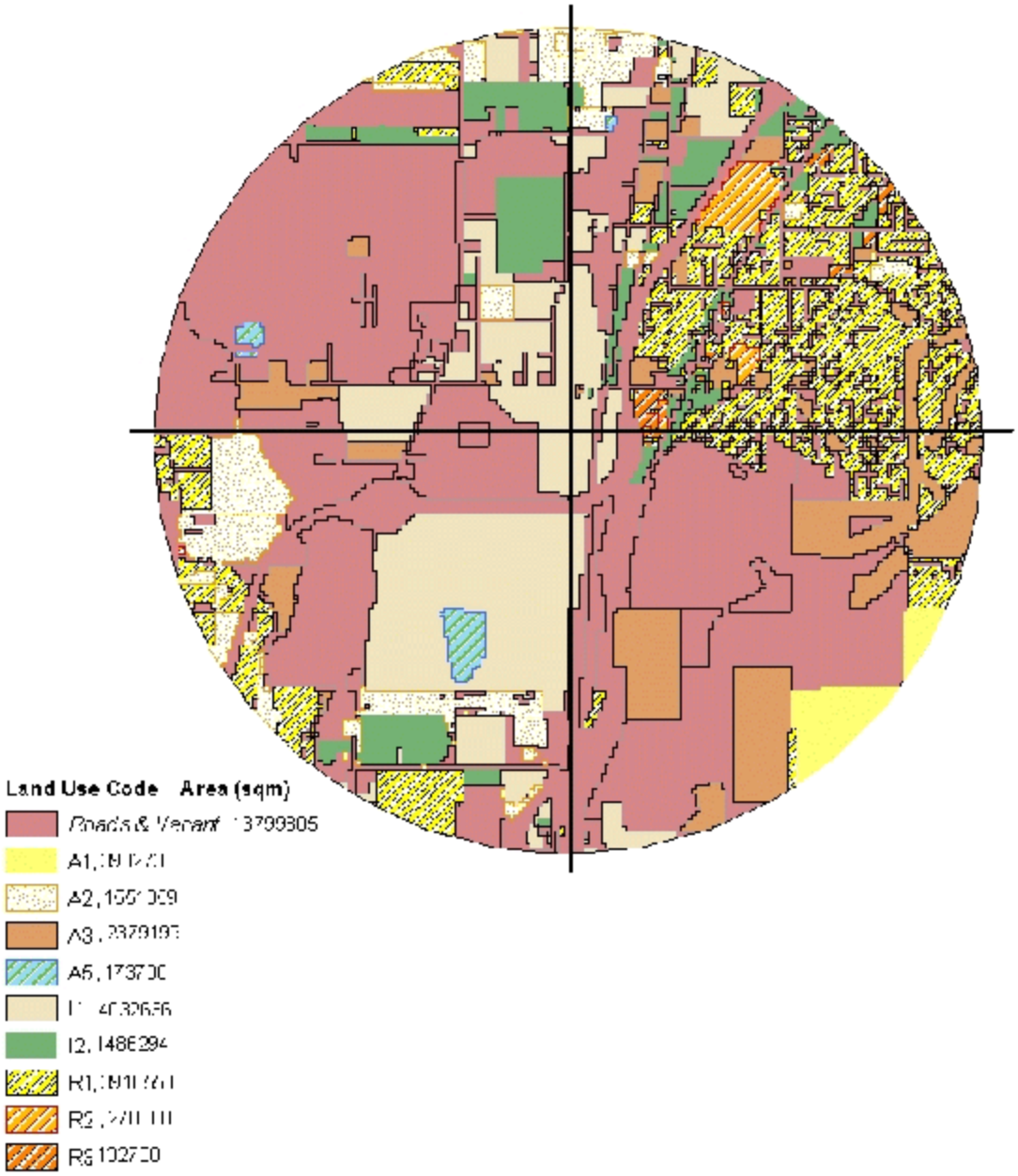


FIGURE III-6
LAND USE WITHIN A 3 KILOMETER RADIUS OF INLAND

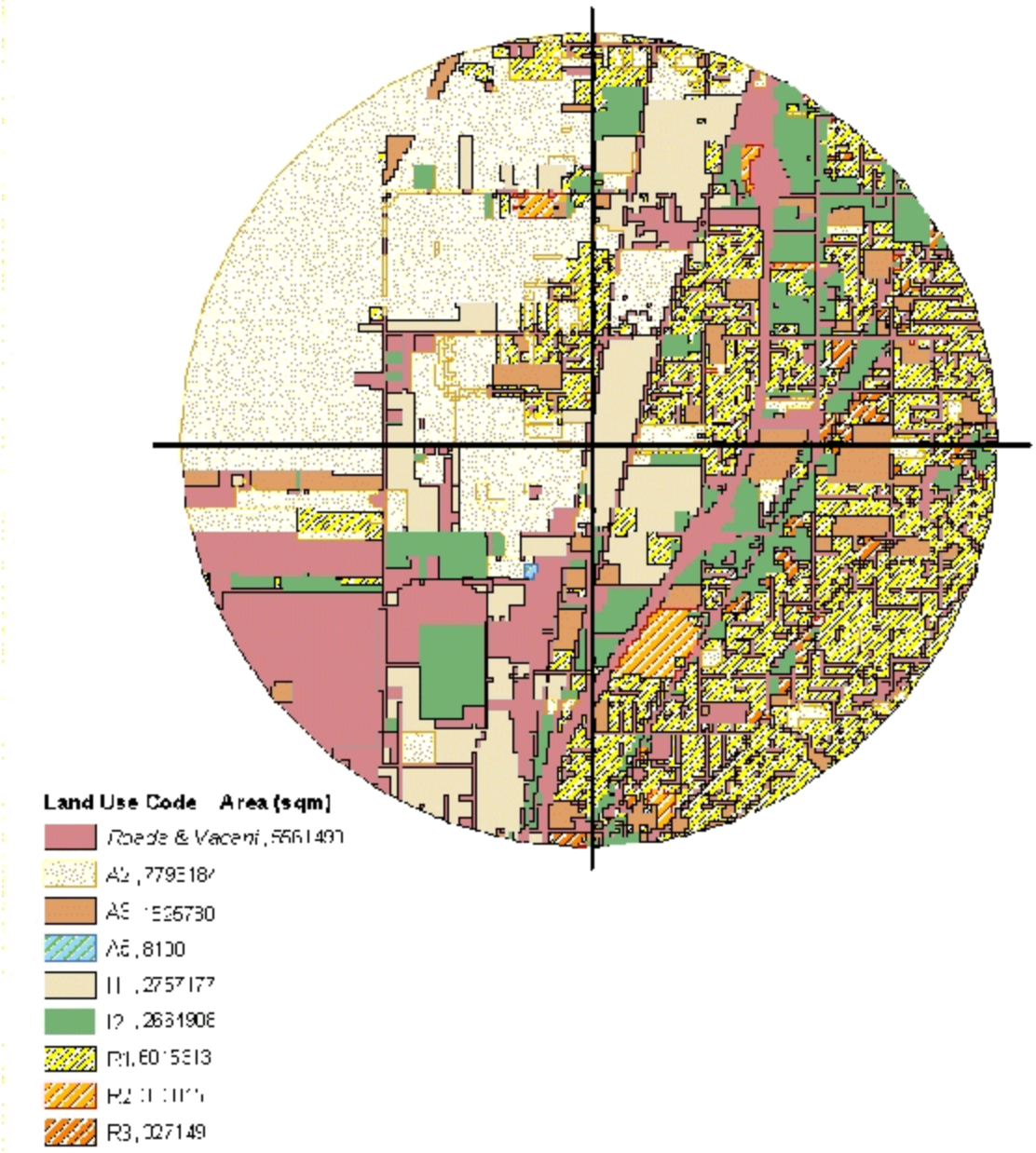
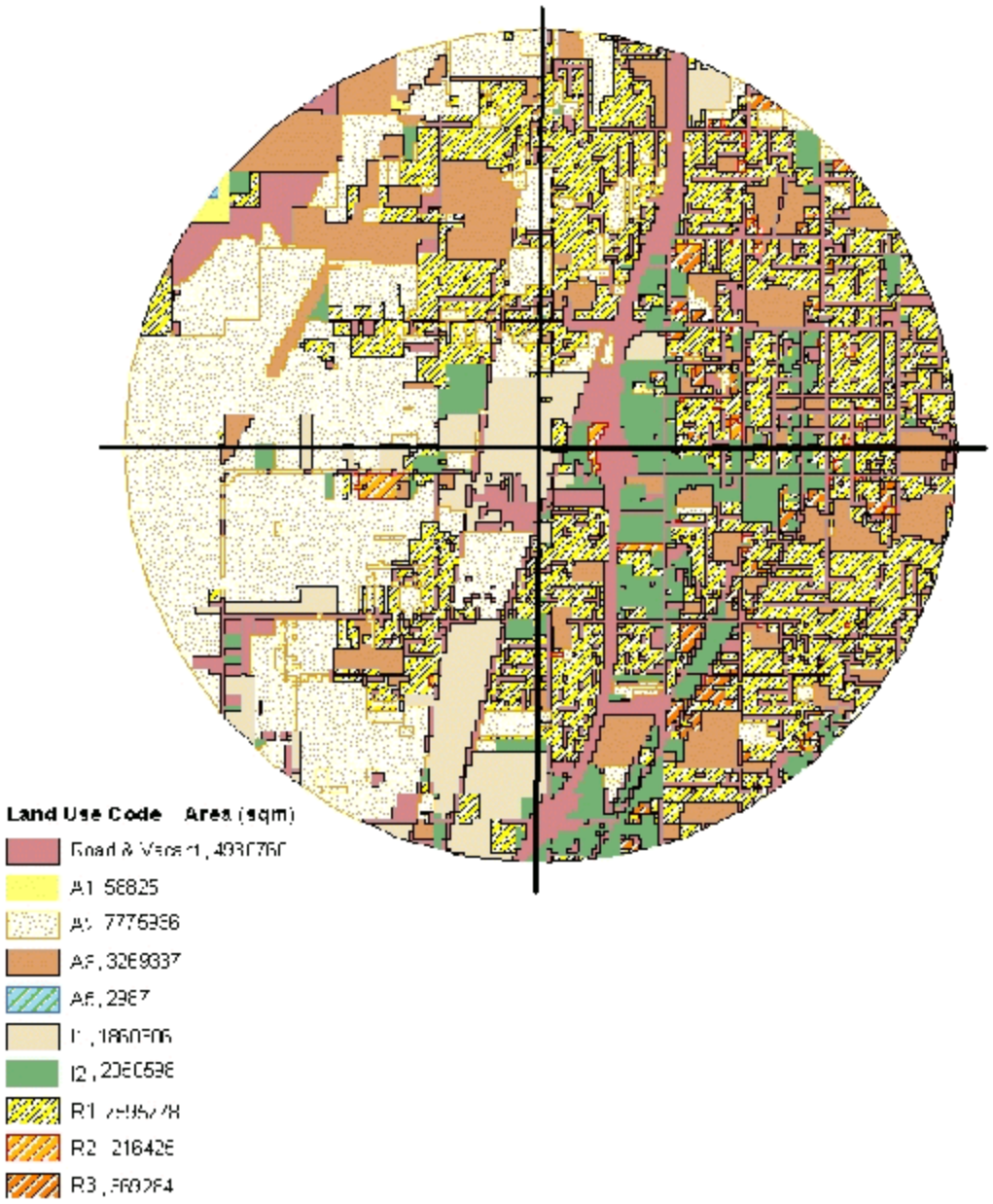


FIGURE III-7
LAND USE WITHIN A 3 KILOMETER RADIUS OF PHILLIPS

To determine the short term and long term representative background concentrations from hourly



measured concentrations, UDAQ followed the guidance in Appendix W of 40 CFR Part 51 and suggestions by USEPA Region 8 (USEPA 2001b) That is, UDAQ took the 98th percentile value from the 3-year period of record to represent background 3-hour and 24-hour air quality levels. The premise for taking the 98th percentile approach was to reduce possible measurements resulting from re-circulated air pollutants. UDAQ also took the highest average of the three calendar years to represent the annual average background. Appendix C contains a detailed description of the derivations of the background concentration levels while Table III-1 displays the background levels.

TABLE III-1
REPRESENTATIVE BACKGROUND CONCENTRATION LEVELS

AIR POLLUTANT	AVERAGING PERIOD	CONCENTRATION (Fg/m^3)
Sulfur Dioxide	3-Hour	33
	24-Hour	24
	Annual	12

1. The short term concentrations are the 98th percentile value while the long term concentration is the highest annual average of three calendar years.
2. Hourly concentrations associated with winds blowing from 135 to 151 degrees and 340 to 260 degrees were excluded from the determining longer average concentrations.

E. Meteorology

Wind data from the UDAQ North Salt Lake monitoring station was combined with other surface and upper air measurements from the National Weather Service station at Salt Lake City International Airport to form the meteorological data base. The Salt Lake City International Airport measured data were obtained from the National Climatic Data Center or downloaded from the Internet. The period of record for the meteorological data base was 1992 to 1995.

UDAQ selected the North Salt Lake wind data over the Salt Lake City International Airport wind data because the North Salt Lake monitoring station is nearer to the terrain and the five refineries (see Section II.D for further discussion). The wind measurement height at North Salt Lake was 10-meters.

F. Stationary Source Emission Rates and Parameters

UDAQ will model the capped and non-capped sources located at the five refineries. Emissions will be based on enforceable permit conditions contained in State of Utah issued Approval Orders. Stack parameters will be based on information contained in UDAQ approved stack tests and data provided by the refineries.

G. Good Engineering Practice Stack Height

USEPA's Building Profile Input Program (BPIP) (USEPA 1995b) will be used to obtain 36 direction specific building heights and widths for each source starting at a 10 degree flow vector and incrementing every 10 degrees in a clockwise rotation. The output from BPIP will be imported into either AERMOD to predict concentrations during wake effects. Should ISC-PRIME be used, then BPIP-PRIME (ETI 1997) will be used to obtain the same information as BPIP as well as building length, and along-flow and across-flow distances from the stack to the center of the upwind face of the projected building.

H. Dispersion Models and Options

The following is a list of common options and assumptions UDAQ will use in performing the air modeling.

- The model regulatory default option will be selected.
- The high, second-high predicted 3-hour and 24-hour concentrations will be used to determine compliance with SO_2 short term NAAQS.
- The highest predicted annual average concentration will be used to determine compliance with the SO_2 long term NAAQS.
- The predicted concentration and the applicable background concentration will be totaled and rounded down to a whole number for comparison with the NAAQS.

UDAQ may use the option MSGPRO in the Control Pathway of the ISC-PRIME input file if missing meteorological are coded following the guidance contained in Appendix F.2 of the user's manual (USEPA 1995a). In addition, surface characteristics representative of the meteorological collection site will be used to derive surface boundary layer characteristics.

1. AERMOD MODELING SYSTEM

a. AERMET Program

AERMET is used to merge and format surface and upper air data for input into the AERMOD model. Two file are generated - a profile and a surface file. The program is also used to perform validation checks on the collected meteorological variable data.

As discussed in Section III.E, representative North Salt Lake 10-meter winds and Salt Lake City International Airport surface and upper air observations form the meteorological data bases for this study. Four years of data from these two locations as well as the surface characteristics will be input into AERMET to generate four separate years of preprocessed data for use with the AERMOD model.

b. AERMAP Program

Questions were raised during the 7th Modeling Conference whether the size of the modeling domain (X, Y, Z) and hence, the calculated height scales, would affect predicted concentrations. To determine the affect of domain size on height scales and predicted concentrations, UDAQ will conduct a sensitivity analysis using five different modeling domains (USEPA 2001b). They are:

i. The first domain uses 3886 receptor points and associated elevations located in Salt

Lake County. These receptor points will be included in an AERMAP run to generate 3886 (X, Y, Z, h_c).

ii. The second domain consists of 24660 receptors points and associated elevations located in Salt Lake and Davis Counties. These receptor points will be included in an AERMAP run to generate 24660 (X, Y, Z, h_t). A subset of 3886 (X, Y, Z, h_t) located in Salt Lake County will be extracted from the AERMAP output file.

iii. The third domain initially contained 24660 receptor points and associated elevations located in Salt Lake and Davis Counties. This domain will be subsequently reduced to 13706 (X, Y, Z) and reflects an area that includes the two mountains east of the Chevron refinery and the BP refinery. The 13706 (X, Y, Z) will be included in an AERMAP run to generate h_t. A subset of 3886 (X, Y, Z, h_t) located in Salt Lake County will be extracted from the AERMAP output file.

iv. The fourth domain is the same as the first except that the eastern edge, which include the terrain, has been reduced by 1900 meters. The (X, Y, Z) will be included in an AERMAP run to generate 2668 (X, Y, Z, h_c).

v. The fifth domain is the same as the first except that the eastern edge, which includes additional the terrain features, has been extended by 6100 meters. The (X, Y, Z) will be included in an AERMAP run to generate 7799 (X, Y, Z, h_c)

The AERMOD dispersion model, one year of processed meteorology from AERMET, sources and emissions from the BP refinery will be run with each of the five modeling domains to predict the top 50 3-hour and 24-hour and top 10 annual concentrations. The predicted concentrations will be plotted and compared. The receptor grid resulting in the greatest concentrations will be used in the SO_2 redesignation modeling. If there is a mix in receptor grids, the most limiting receptor grid (period concentration nearest the standard) will be used for all averaging times.

c. AERMOD Program Run

UDAQ will take the refinery emissions inventories, the output from AERMAP, AERMET and BPIP, and use them as input data to run the AERMOD model to predict concentrations in terrain. AERMOD runs will be completed for each refinery using their source area surface characteristics and the regulatory default option.

2. ISC-PRIME Model

a. General

If needed, the ISC-PRIME model will be used to predict concentrations during a wake effect situation. It is the same as ISCST3 except the PRIME downwash algorithm replaces the Huber-Snyder and Schulman-Scire downwash algorithms in the code.

b. Meteorological Processor for Regulatory Models

The Meteorological Processor for Regulatory Models (MPRM) program (USEPA 1999) will be used to process the surface and upper air data discussed in Section III.E. The processing

is similar to AERMET. However, unlike AERMET, only one meteorological file is generated and stabilities classes are included in the output file. The surface characteristics used in AERMAP will also be used here.

c. ISC-PRIME Model Run

UDAQ will take the refinery emissions inventories, the output file from MPRM and BPIP-PRIME, and the receptors generated from AERMAP minus h_c, to run ISC-PRIME to quantify concentrations from wake effects. ISC-PRIME runs will be completed for each refinery using their plant boundary and the regulatory default option

I. Compliance with Air Standards

Compliance with the SO_2 short term NAAQS will be based on the highest, second-highest predicted concentrations. Similarly, compliance with the SO_2 long term NAAQS will be based on the highest annual average concentration.

V. REFERENCES

40 CFR Part 51. Code of Federal Regulations (Title 40, Part 51): Protection of the Environment; Requirements for Preparation, Adoption, and Submittal of Implementation Plans.

40 CFR Part 58. Code of Federal Regulations (Title 40, Part 58): Ambient Air Quality Surveillance.

Auer, A. H., Jr., 1978. Correlation of Land Use and Cover with Meteorological Anomalies. Journal of Applied Meteorology, 17, 636 - 643.

ETI (Earth Tech, Inc.) 1997. Addendum to ISC3 User's Guide, The Prime Plume Rise and Building Downwash Model. Concord, MA. November.

USEPA (U.S. Environmental Protection Agency) 1987. Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD). EPA-450/4-87-007. Office of Air Quality Planning and Standards, Research Triangle Park, NC. May.

USEPA 1992a. Letter from Doug Skie, Chief, Air Programs Branch to Mr. F. Burnell Cordner, Director, Division of Air Quality, Department of Environmental Quality. Region VIII, Denver, CO.

USEPA 1992b. Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised. Office of Air and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, NC. October.

USEPA 1995a. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, Volume I - User Instructions. EPA-454/B-95-003a. Office of Air Quality Planning and Standards, Monitoring and Analysis Division, Research Triangle Park, NC. September.

USEPA 1995b. User's Guide to the Building Profile Input Program. Revised. EPA-454/R-93-038. Office of Air Quality Planning and Standards, Technical Support Division, Research Triangle Park, NC. October.

USEPA 1998a. Revised Draft User's Guide for the AMS/EPA Regulatory Model - AERMOD. Office of Air Quality Planning and Standards, Monitoring and Analysis Division, Research Triangle Park, NC. November.

USEPA 1998b. Revised Draft User's Guide for the AERMOD Terrain Preprocessor (AERMAP). Office of Air Quality Planning and Standards, Monitoring and Analysis Division, Research Triangle Park, NC. November.

USEPA 1998c. Revised Draft User's Guide for the AERMOD Meteorological Preprocessor (AERMAP). Office of Air Quality Planning and Standards, Monitoring and Analysis Division, Research Triangle Park, NC. November.

USEPA 1999. Meteorological Processor for Regulatory Models (MPRM) User's Guide with Addendum. EPA-454/B-002. Office of Air Quality Planning and Standards, Monitoring and Analysis Division, Research Triangle Park, NC. June.

USEPA 2000a. Email correspondence between USEPA Region 8 Regional Meteorologist and UDAQ Meteorologist. July 5.

USEPA 2000b. Email correspondence between USEPA Region 8 Regional Meteorologist and UDAQ Meteorologist. August 14.

USEPA 2000c. Email correspondence between USEPA Region 8 Regional Meteorologist and UDAQ Meteorologist. September 1.

USEPA 2000d. Email correspondence between USEPA Office of Air Quality Planning and Standards and UDAQ Meteorologist. September 8.

USEPA 2000e. USEPA Region 8 letter. 999 18th Street, Suite 3000, Denver, CO. December 7.

USEPA 2001a. Conference call with Laurie Ostrand and Kevin Golden. January 9.

USEPA 2001b Meeting with Kevin Golden at UDAQ. Salt Lake City, UT. June 13.

APPENDIX A
USEPA REGION 8 COMMENT LETTER OF DECEMBER 7, 2000

APPENDIX B
URBAN/RURAL DETERMINATION

APPENDIX C
BACKGROUND CONCENTRATION

Background Concentrations

The UDAQ calculated the sulfur dioxide 3-hour, 24-hour, and annual average concentrations using hourly measured data from the North Salt Lake monitoring station for the period 1994 to 1996. Two USEPA references were specifically followed by UDAQ to obtain other than 1-hour concentrations. They were:

(1) Section 9.2.2 in Appendix W of 40 CFR Part 51, which allows the calculation of background concentrations to be based on those hours when the stationary source in question is not contributing to the measured concentration at the monitoring station. In this modeling study, winds from 135 to 151 degrees would transport the BP refinery plume to the monitoring station. Similarly, winds from 340 to 360 degrees would transport the Chevron refinery plume the same monitoring station. Measured concentrations for those hours when the winds were blowing from these two sectors were excluded from analysis.

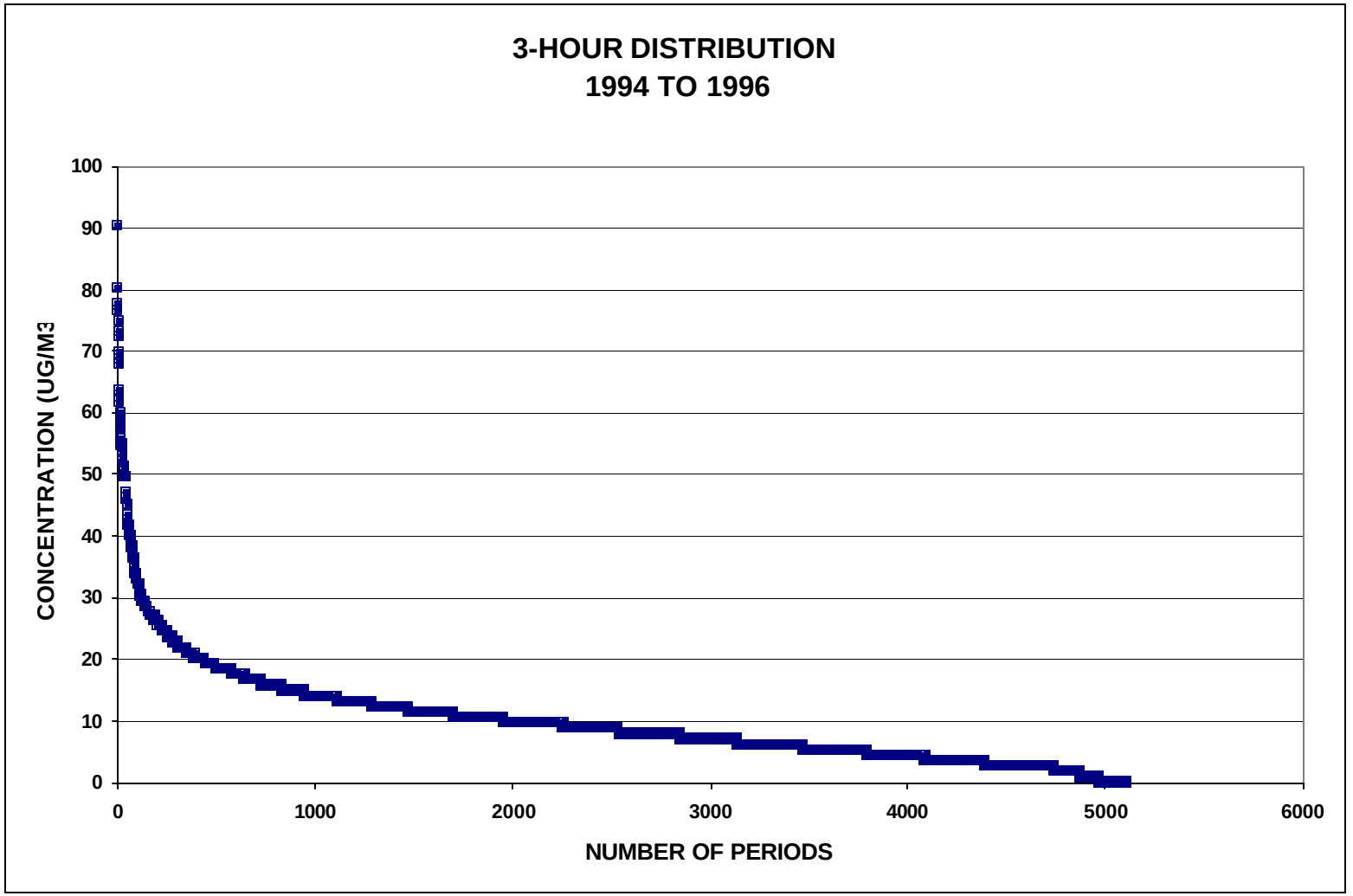
(2) 40 CFR Part 50.4 and 50.5, which provided the procedures to calculate 3-hour, 24-hour average and annual average concentrations from measured data.

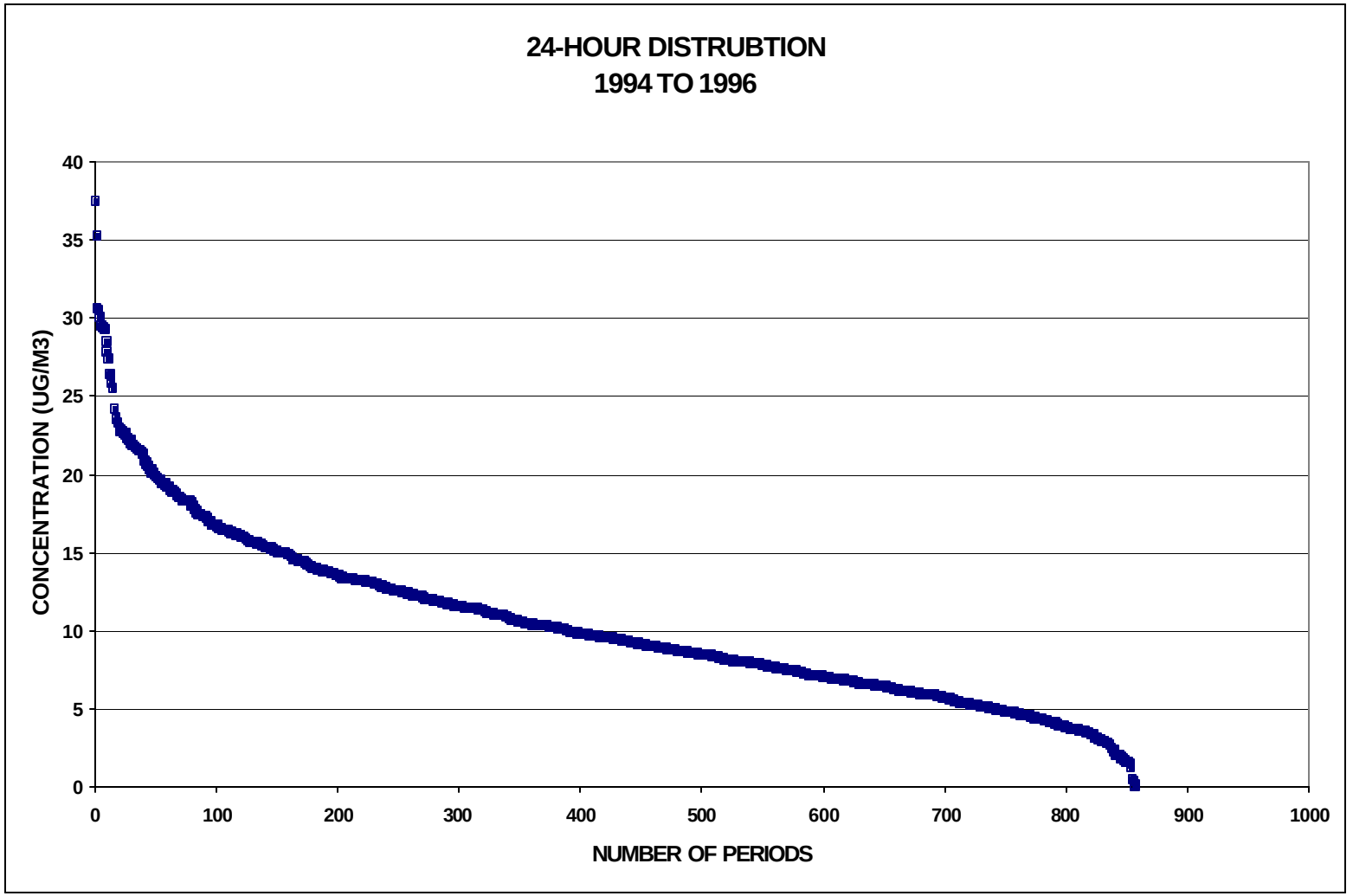
Section 9.2.2.b of the Guideline on Air Quality Models does not explicitly state what numerical value should be used to represent a short term background level (e.g. the average of all the 3-hour average calculated concentrations, the highest of all the 3-hour averaged calculated concentrations, the second highest of all the 3-hour average calculated concentrations, or a specific percentile). Rather, it states that the "One hour concentrations may be added and averaged to determine longer averaging periods" which is consistent with 40 CFR Part 50.4 and 50.5 for sulfur dioxide.

Without specific guidance, UDAQ has interpreted this to mean that it has the discretionary authority to establish the background value for each averaging period that should be used in the modeling study. These background values are shown in the below table and are based on the 98th percentile value of the 3-hour and 24-hour average concentrations. UDAQ believes that using the 98th percentile would reduce questionable calculated concentrations and still protect the air quality standards from being violated. The highest calculated annual average concentration among the three years will be used to represent the long term background level.

Period	Concentration ($\mu g/m^3$)
3-hour	33
24-hour	24
Annual	11

Excluding the two wind direction sectors, there were 5106 valid 3-hour measurements which translates to a 58 percent recovery rate. Similarly, there were 856 valid 24-hour measurements which results in a 78 percent data recovery. Below are two plots showing the distribution of the 3-hour and 24-hour concentrations.


3-HOUR DISTRIBUTION
1994 TO 1996
CONCENTRATION (UG/M3
100
90
80
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
6000
NUMBER OF PERIODS


24-HOUR DISTRUBTION
1994 TO 1996
CONCENTRATION (UG/M3)
40
35
30
25
20
15
10
5
0
0
100
200
300
400
500
600
700
800
900
1000
NUMBER OF PERIODS